SUMMARY OF FINAL REPORT

Radiological Recovery Concepts, Requirements, and Structures

Summary by

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and
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This is a summary of a report which has been reviewed in the Office of Civil Defense and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Office of Civil Defense.

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I. OBJECTIVES OF THE STUDY

This report is a summary of the final report (References 1 and 2) on the research completed under the Office of Civil Defense Contract OCD-PS-64-56, Subtask 3233B. The objective of the research was to analyze decontamination operations to determine their costs, feasibility, and potential contribution to accelerating recovery in a postattack fallout environment. This objective was met by determining alternative times, and associated decontamination resources, required to resume a work schedule, as a function of decontamination effort. The principal measure of effectiveness was the time saved in resuming the schedule.

This research was designed to support the more general objectives of the overall postattack research program. This larger program is to provide planners at all levels with the necessary analyses on which to:

(1) base realistic planning documents,

(2) implement effective training programs,

(3) procure and preposition essential decontamination equipment and material, and

(4) design a system for coordination and control of decontamination measures.

In the course of the research, it was mutually agreed by RTI and OCD that increased emphasis would be placed on detailed calculation of dose reduction in real structures due to decontamination. This necessitated that

little research be directed towards analysis of trade-offs among man-power, decontamination resources, and time to resume a work schedule. Most of the basic data required for such analyses are, however, included in Reference 2.

II. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

On the basis of an analysis of the costs and dose reduction achievable in practice by decontaminating nine representative structures, it is concluded that decontamination operations in a fallout environment are as vital to postattack recovery as shelters are to postattack survival. Specifically, it is concluded that:

(1) Practicable decontamination methods can reduce the denial time in most cases by at least a factor of ten. (Denial time is the length of time after fallout arrives that must elapse before an activity can be safely resumed in a fallout contaminated area.) In many cases, decontamination can reduce the denial time to the extent necessary to allow the safe recovery of activities at the scheduled time of shelter emergence, H+2 weeks, assuming the fallout shelter was effective in keeping the radiation dose well below lethal levels.

(2) Practicable decontamination methods can increase the radiation protection associated with an individual inside a structure by at least a factor of five, and can increase the radiation protection associated with an individual outside a structure (in an urban area) by at least a factor of twenty.

(3) In the range of levels of fallout removal studied (90 to 99 %), inside protection improvements are insensitive to the level, but outside improvements are very sensitive.

(4) Effective decontamination can be performed without the decontamination crews accumulating a significant radiation dose. In most cases, an activity area can be decontaminated at H+2 weeks with a crew dose of less than 10 roentgens per man at H+1 hour reference intensities below 10,000 r/hr. To this must be added any dose received in transit, which in practical situations should be slight (10 r/hr or less dose rates under the above conditions).

More specific conclusions and supporting examples are presented in the appendices of Reference 2 and in Chapters 2, 3, and 4 of Reference 1.

These conclusions are substantiated by the analyses performed in deriving the radiological recovery planning guides to be discussed in paragraph IV and Enclosure (1) below.

B. Recommendations

Since the conclusions of this study are based on the analysis of single activities and functions, it is advisable to validate the significant conclusions in the context of a coordinated recovery of metropolitan areas. Hence, it is recommended that these studies be extended to examine:

(1) the extent to which decontamination can accelerate the recovery of large regions in a metropolitan area involving many activities, and the associated costs;

(2) the pre-attack and postattack data required for decontaminating city areas with various levels of effort and/or capability, and

(3) the nature and scope of command and control systems required for coordinating effective decontamination countermeasures in metropolitan areas.

III. ASSUMPTIONS

The following assumptions and restrictions were established for this research in conjunction with the Office of Civil Defense:

(1) Direct weapons effects are excluded from the spectrum of attack environments considered.

(2) Extreme natural environments, such as sustained freezing weather, are excluded from direct study.

(3) Only the whole body gamma radiation hazard from fallout is considered; beta burns and ingestion of radioactive materials are excluded.

IV. SUMMARY OF ACCOMPLISHMENTS

In this study, the effectiveness of the decontamination operation is measured by the fractional reduction that is achieved in dose rate, dose (both total and maximum ERD), and denial time. These reductions are analyzed as functions of:

(1) the time when decontamination is carried out,

(2) the H+1 hour intensity of the local fallout field,

(3) the radiation protection afforded by the physical surroundings,

(4) the characteristics of the activities to be resumed in the decontaminated areas, and

(5) the efficiency and cost characteristics of the methods and equipment used to decontaminate the area.

The various costs involved in the operation are measured by the man-hours of labor, the machine-hours of equipment, the gallons of water expended, the amount of fuel used, and the radiation doses received by the decontamination

crew members. Enclosure (1) contains abstracts of the specific analyses performed in accomplishing the above tasks.

These analyses are then used to develop a set of operational planning guides. These guides allow the rapid determination of:

(1) The reductions in total dose and maximum equivalent residual dose received in the early postattack period (first two weeks), that can be achieved by reducing the dose rate during the early post-attack period.

(2) Alternative recovery times for activities and associated decontamination resource equipment as a function of the type of activity, the method of decontamination, and the selected H+1 dose rate in the area.

An analysis is also included which allows calculation of the reductions in dose rate that can be achieved with a specified level of effort (manpower and equipment) by decontaminating the accessible contaminated planes on and adjacent to a structure.

The operational application of these planning guides depends on the availability of data that describe:

(1) resource availability (personnel and equipment),

(2) area radiation environment information necessary to coordinate the recovery of several activities,

(3) activity radiation environment information necessary to plan the recovery of a single activity, and

(4) activity recovery priorities necessary to allocate limited resources for effective area recovery.

REFERENCES

1. J. T. Ryan, J. D. Douglass, Jr., and H. E. Campbell. Radiological Recovery Concepts, Requirements, and Structures. Final Report: Volume I, General Considerations. Office of Civil Defense Project 3233B. Durham, North Carolina: Research Triangle Institute, 16 October 1964.

2. J. T. Ryan, J. D. Douglass, Jr., and H. E. Campbell. Radiological Recovery Concepts, Requirements, and Structures. Final Report: Volume II, Specific Considerations and Supporting Documents. Office of Civil Defense Project 3233B. Durham, North Carolina: Research Triangle Institute, 16 October 1964.

Enclosure (1)

Summary of Volume II - Specific Considerations and Supporting Documents

Volume II (Reference 2) contains five studies concerned with determining the costs and effectiveness of decontamination applied to postattack recovery in a fallout environment. These studies cover the following subjects:

(1) The Effect of Early Decontamination on Total Dose: This study describes the effect of a single (discrete) reduction in radiation intensity (i.e., by decontamination) on an individual's dose history in a $t^{-1.2}$ radiation field;

(2) The Effect of Early Decontamination on ERD: This analysis is like the first in describing the effect of a single reduction in radiation intensity, except that an individual's dose is measured in terms of his ERD;

(3) Total Dose Approximations for Brief Exposure in a Fallout Environment: Two approximations to the expression used to calculate total dose for a finite exposure time in a t^{-k} radiation fields are developed and the resultant error is estimated. The approximations are then used to determine the earliest time of entry (for a fixed allowable dose) when a given countermeasure operation, such as decontamination, is employed;

(4) The Effectiveness of Radiological Countermeasures in Accelerating Postattack Recovery: This study develops the parametric relationships that determine which radiological countermeasures could accelerate the postattack recovery process; e.g., time saved in recovering an activity as a function of the duration of the activity, the allowable dose received by the activity personnel, the fallout reference intensity, and the effect of decontamination on the intensity.

(5) Studies of Decontamination Effectiveness: This analysis determines the costs and effectiveness of decontamination on and around nine MUS structures. Reductions in the dose rate inside or near the structures are determined. A parametric analysis of a fictitious structure is also included in order to examine certain parameters (floor and wall weights, story of the detector, number and size of apertures, etc.) in a controlled manner to determine their contribution to dose rate reduction. A similar parametric analysis is made of streets and intersections in an urban area.